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(54) Calcination of slurries

(57) A granulated slurry, e.g. of $CaCO_3$, is calcined in at least two temperature stages (30, 31, 32) in a fluidized bed installation (9) with directed movement through the stages. The temperatures in the respective steps (30, 31, 32) can be individually controlled to ensure that the temperature in the hottest stage (32) corresponds to a predetermined degree of decomposition of calcium carbonate. Typically the hottest stage is at a temperature of at least 880°C, whilst the temperature of the other stage or stages is lower.

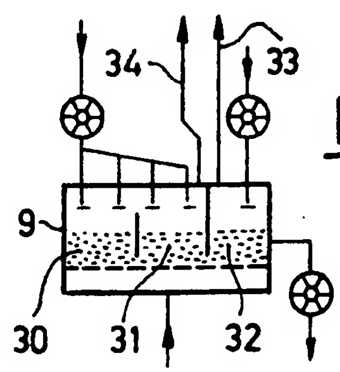

Fig. 2

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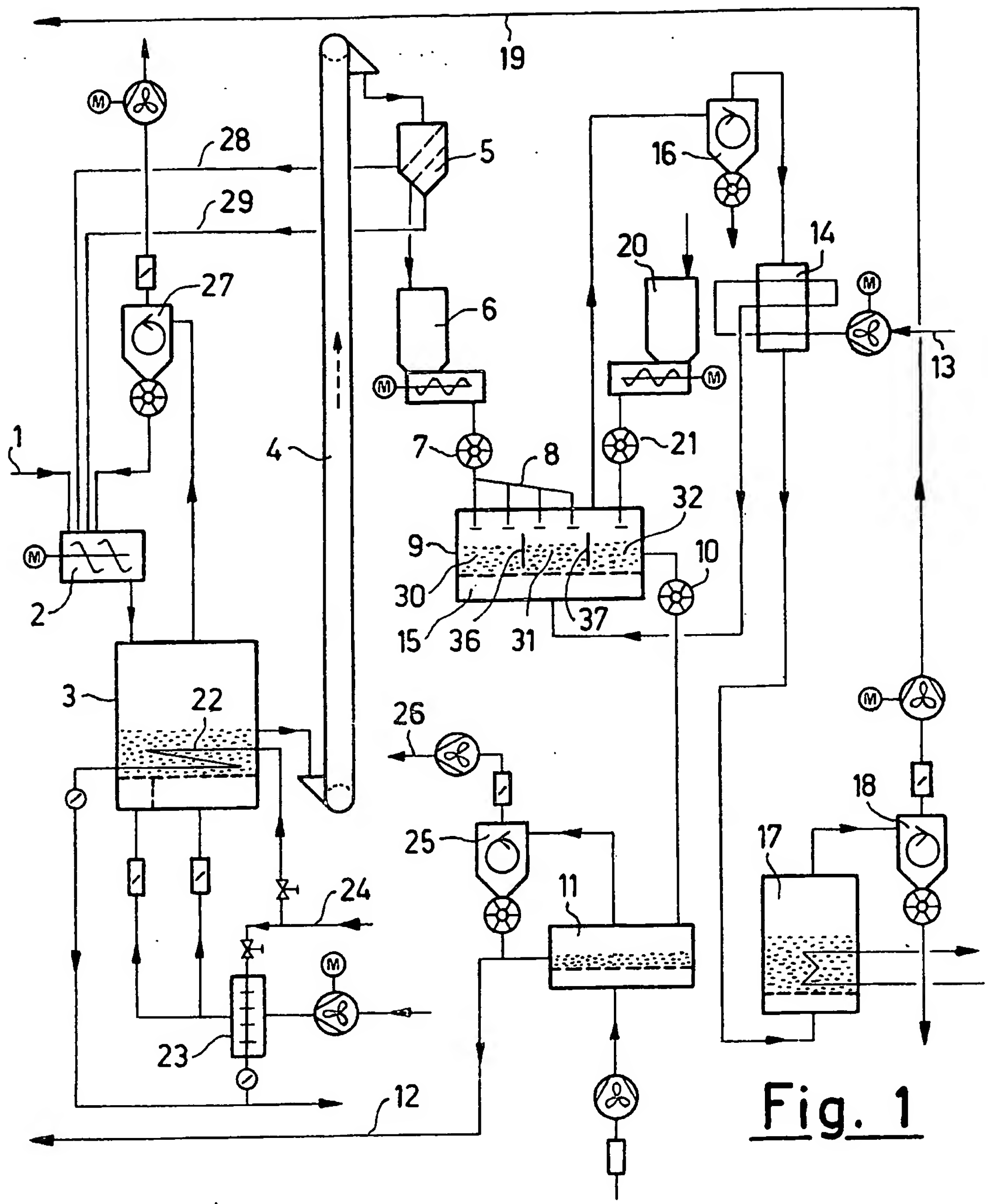


Fig. 1

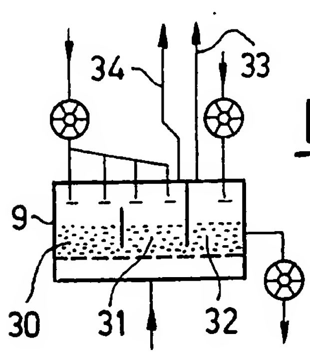
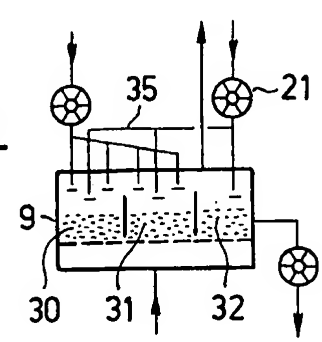


Fig. 2

Fig. 3



SPECIFICATION

A method and apparatus for calcination of a slurry containing calcium carbonate

The invention relates to a method and apparatus for calcining a slurry containing calcium carbonate. It relates particularly to the calcination of such a slurry after it has been previously granulated.

In industrial processes, for example in the manufacture of soda, in a sugar factory in purifying syrup, or in the manufacture of cellulose, a slurry or waste liquor containing calcium carbonate is frequently obtained as a waste product. In order to avoid the costly deposition of this slurry and to reduce the consumption of limestone, it is suggested that the slurry or waste liquor be calcined. In known methods for calcining slurry, it is first converted into a solid form, for example granulated. On heating up to the calcination temperature however, so much dust is produced that the heat recovery apparatus is clogged after a very short time.

We have found that gas formation in heating up granulated material damages the individual granular particles. The present invention is directed at the provision of means by which the granulated material can be heated in such a way that the granular particles are protected from damage as much as possible. According to the invention, the granulated material obtained from a slurry containing calcium carbonate is calcined in a fluidized state in at least two temperature stages. The temperature stage with the highest temperature is expediently selected such that it corresponds to the required decomposition degree of calcium carbonate. In practice, we have found that the output within an available period of time assumes a practicably usable value when the higher or highest temperature stage is at at least 880°C. while the other temperatures are correspondingly graduated and lie below 880°C.

The particles of granulated material are particularly well protected if the granulate temperature of the temperature stages increases from stage to stage in the direction of movement of the granulated material. Preferably, calcination takes place on combustion of organic matter which may be already contained in the granulated slurry, for example molasses, or which may be added in one or more of the temperature stages. Preferably, organic matter is admixed at least to the fluidised granulated material in the temperature stage with the highest temperature. On the other hand, it is preferable if at least in the temperature stage with the lowest temperature, the organic matter contained in the granulated material serves solely as fuel for calcination. If the slurry which is to be calcined does not contain any organic matter, it is advantageous if for all temperature stages organic matter is admixed to the fluidized granulated material as fuel for calcination.

The granulated material may be fed not only to the lowest temperature stage, but also to the granulated material which is in a fluidized state, in further temperature stages following the temperature stage with the lowest temperature.

On granulation and drying of the slurry, preferably a temperature is used at which any organic matter is not yet converted into the gaseous state. It is also advantageous if the granulated material is sifted prior to passage to the fluidized stage, to a required size of granular particle.

In the calcination, for the combustion of the organic matter, each stage is normally carried out stoichiometrically or with excess air. The waste gas from a temperature stage operating with excess air is preferably drawn off separately from the waste gas from the remaining temperature stages.

Apparatus for carrying out the method according to the invention comprises a fluidised bed installation which is subdivided in two more temperature stages in the direction of movement of the granulated material. The fluidised bed installation preferably has at least one barrier subdividing the fluidised granulated material, which barrier is advantageously in the form of a lower course barrier.

The fluidized bed installation may have an air supply box common to all temperature stages, whilst regulators are provided for the addition of the granulated material and/or the organic matter into the fluidized granulated material. The exhaust box of the fluidized bed installation can have at least one partition separating two temperature stages. However, the air supply box of the fluidized bed installation can also be subdivided into stages of varying air temperature.

The invention will now be described by way of example and with reference to the accompanying schematic drawing wherein:

Figure 1 shows a calcination plant in block diagram form; and

Figures 2 and 3 show alternative forms of installation suitable for the plant of Fig. 1.

The plant shown in Fig. 1 for calcination of a slurry containing calcium carbonate has a delivery pipe 1 for the slurry; for example, molasses originating from the manufacture of sugar. The slurry is granulated in a granulator 2. The granulated material is dried in a drier 3 and is fed to a sifter 5 via an elevator 4. The sifted portion of the granulated material passes into a silo 6 and is introduced into a fluidized bed installation 9 by a dosing device 7 via pipes 8. The granulated material, which is calcined to caustic lime in the fluidized bed installation, is fed through a further dosing device 10 to a fluidised bed cooler 11, and after cooling is returned to the sugar manufac-

turing plant for re-use by means of a pipe 12.

Operating air is fed in through a pipe 13, is heated up in a heat exchanger 14 and is passed into the air supply box 15 of the fluidised bed installation 9.

The waste gas containing carbon dioxide from the fluidized bed drier 9, arrives into the heat exchanger 14 via a dust separator 16, and finally via a further heat exchanger 17 and a dust separator 18 into a pipe 19, which returns the gas for re-use in the sugar manufacturing plant.

Organic matter, for example, waste coke, is fed to the fluidised bed installation 9 via a silo 20 and a dosing device 21.

The drier 3 is in the form of a fluidized bed drier. It has a heating coil 22 lying in the fluidized bed. The air supply to the air supply box of the drier 3 passes through a heat exchanger 23. The heating coil 22 and the heat exchanger 23 are heated through a steam pipe 24.

A dust separator 25 is provided for the waste gases of the fluidised bed cooler 11, from which the exhaust air escapes via a pipe 26. The dust from the dust separator 25 is passed into pipe 12.

The exhaust air of the drier 3 is discharged via a dust separator 27. The dust which is separated in the dust separator 27 returns to the granulation installation 2. The coarse and fine material, which is graded out at the sifter 5, also returns to the granulator 2 via pipes 28 or 29.

The granulated material to be treated is calcined in the fluidised bed installation 9 in at least two, as illustrated in three temperature stages 30, 31 and 32 on combustion of the organic matter contained in the granulated material, and in the third temperature stage 32 on combustion of the organic matter introduced via the dosing device 21.

The temperature of the highest temperature stage is to be selected such that it corresponds to the required degree of decomposition of calcium carbonate. The relevant consistency is known to the specialist in the art. Good output can be achieved if the highest temperature stage is selected at least 880°C, the temperature required for complete calcination.

In the example embodiment described, the highest temperature stage is at 930°C. The preceding temperature stages 31 and 30 in the direction of movement of the granulated material to be treated, have a temperature of less than 880°C, i.e. temperature stage 31 has a temperature of 860°C, and temperature stage 30 has a temperature of 830°C. The temperature of the temperature stages therefore increases from stage to stage in the direction of movement of the granulated material.

In the fluidized bed installation 9, the calcination is therefore subdivided into steps, whereby the generation of gas in the granular particles is decelerated such that the particles are not destroyed. Furthermore, the granular particles are, as is well known, treated extremely carefully in a fluidized bed. Therefore, crushing of the particles does not result and there is scarcely a formation of dust.

The pipe 8 not only feeds granulated material to be treated into the first temperature stage 30 of the fluidized bed installation, but also into the second temperature stage 31. However, no fresh granulated material is fed into the final temperature stage 32, so that no incompletely calcinated granular particles can leave the fluidized bed installation 9. To regulate the degree of calcination in the individual temperature stages, however, organic matter (coke) could also be fed via the dosing device 21 into the second temperature range 31 or even into the first temperature stage 30 as well.

In order that all organic matter contained in the granulated material can be fed, still unburned, into the fluidised bed installation 9, on granulation and drying of the slurry and on drying of the granulated material in the drier 3, a temperature is used in which the organic matter is not yet converted into the gaseous stage, i.e. a temperature of 60°–200°C.

Regulation of the fluidized bed installation 9 becomes very simple, if the operation for combustion of the organic matter is carried out with excess air, the supply of air to the air supply box 15 is kept constant and the feeding in of granular material through the dosing device 7 and the pipe 8 is likewise kept constant. By regulating the dosing device 21 for the organic matter to be introduced in the final temperature stage 32, the degree of calcination of the granulated material leaving the fluidized bed installation 9 for example the complete recalcination, can be regulated.

In the installation 9 represented in Fig. 2, the exhaust chamber is also subdivided. The waste gases of the third or final temperature stage 32 leave the fluidised bed installation through a separate pipe 33, with a greater proportion of air, whilst the waste gases of the temperature stages 30 and 31 with the least proportion of foreign matter and correspondingly large proportion of carbon dioxide, are passed into the dust separator 16 via a pipe 34.

The installation 9 shown in Fig. 3 serves for the calcination of a slurry containing calcium carbonate, which does not contain any organic matter, for example, for the slurry containing calcium carbonate from the manufacture of soda. The dosing device 21 feeds the organic matter necessary for heat generation, via a pipe 35 into several temperature stages 30, 31 and 32.

In the embodiments illustrated the temperature stages 30, 31 and 32 are constructed such that the fluidized bed installation has one

or more i.e. two barriers 36, 37 subdividing the flow of the fluidized granulated material. As is evident for Fig. 1, the barriers are in the form of a lower course barrier, i.e. they allow a through flow. The construction as lower course barriers permits a thermal flow from the temperature stages of higher temperature into temperature stages of lower temperature i.e. against the flow of the fluidised granulated material.

The barrier 37 of Fig. 2 is extended upwards to the cover of the exhaust gas box of the fluidised bed installation 9. The extension forms a partition in the exhaust gas box.

CLAIMS

1. A method for the calcination of a slurry containing calcium carbonate, wherein the slurry is granulated and then calcined in a fluidised state in at least two temperature stages.

2. A method according to Claim 1, wherein the temperature ranges in the respective stages increase in the direction of movement of the granulated material.

3. A method according to Claim 1 or Claim 2 wherein the temperature stage with the highest temperature corresponds to a given degree of decomposition of calcium carbonate.

4. A method according to Claim 2 and Claim 3 wherein the temperature of the highest temperature stage is at least 880°C, and wherein the temperatures of the preceding temperature stages are less than 880°C.

5. A method according to any preceding Claim wherein calcination takes place on combustion of organic matter.

6. A method according to Claim 5 wherein, at least in the temperature stage with the highest temperature, organic matter is admixed to the fluidized granulated material.

7. A method according to Claim 6 wherein organic matter is admixed to the fluidised granulated material, as fuel for calcination in each temperature stage.

8. A method according to any of Claims 5 to 7 wherein for the combustion of the organic matter, the operation is carried out stoichiometrically or with excess air.

9. A method according to any of Claims 5 to 8 wherein the waste gases from the temperature stage with the highest temperature are drawn off separately from the waste gases from the other temperature stages.

10. A method according to any of Claims 5 to 9 wherein organic matter is contained in the granulated material.

11. A method according to Claim 10 wherein at least in the temperature stage with the lowest temperature, the organic matter contained in the granulated material serves solely as fuel for calcination.

12. A method according to Claim 10 or Claim 11 wherein the slurry is granulated and dried at a temperature at which the organic matter is not yet converted into the gaseous state.

13. A method according to any preceding Claim wherein some granulated slurry bypasses the temperature stage with the lowest temperature.

14. A method according to any preceding Claim wherein the granulated material is sifted to a required size of granular particles before calcination.

15. A method according to Claim 14 wherein the residue from the sifted granulated material, divided into coarse and fine granular particles, is returned to the granulating device for the slurry.

16. A method according to any preceding Claim wherein the calcinated material is cooled to its re-use temperature in a fluidised bed cooler, the waste heat from the fluidised bed cooler being used to dry granulated material to be calcinated.

17. A method according to any preceding Claim wherein waste gases containing carbon dioxide and produced in the calcination, are passed through a first heat exchanger, to heat air to be added to the fluidised granulated material, and are then cooled in a second heat exchanger, by waste heat recovery, to a re-use temperature.

18. A method according to Claim 17, characterized in that the waste heat from the second heat exchanger is used, under indirect heat transfer, to dry the granulated material.

19. A method for the calcination of a slurry containing calcium carbonate substantially as described herein with reference to the accompanying drawings.

20. Apparatus for carrying out a method according to any preceding Claim comprising a fluidised bed installation which is subdivided in two more temperature stages in the direction of movement of the granulated material.

21. Apparatus according to Claim 20 wherein the installation is subdivided by at least one barrier within a common housing.

22. Apparatus according to Claim 21 wherein at least one barrier is in the form of a lower course barrier.

23. Apparatus according to any of Claims 20 to 22 wherein the installation includes an exhaust gas box having at least one partition separating two temperatures stages.

24. Apparatus according to any of Claims 20 to 23 wherein the installation has an air supply box common to all temperature ranges, and regulators for the supply of granulated material, and/or organic matter into the fluidised granulated material.

25. Apparatus according to Claim 24 wherein the air supply box is subdivided into stages of varying air temperature.

26. Apparatus for the calcination of a slurry containing calcium carbonate substan-

tially as described herein with reference to Fig. 1 of the accompanying drawing, or as modified according to Fig. 2 or Fig. 3.

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